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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/863,647	05/23/2001	Chingfu Lin	JCLA6353	1042

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EXAMINER

NOVACEK, CHRISTY L

ART UNIT PAPER NUMBER

2822

DATE MAILED: 04/08/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/863,647

Applicant(s)

LIN ET AL.

Examiner

Christy L. Novacek

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 May 2001.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02 May 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

This Office Action is in response to the communication filed May 23, 2001.

Claim Objections

Claims 1, 3, 4, 9 and 10 are objected to because of the following informalities:

Line 12 of claim 1 recites the limitation of “the trench”. This limitation lacks antecedent basis. A “trench” is not recited as being formed until line 14 of the claim. The limitation of “the trench” in line 12 of the claim should be replaced with “the opening” (line 11 of the claim recites forming “an opening”).

Claims 3 and 9 recite the limitations of “the etching step”. However, claims 1 and 7, upon which claims 3 and 9 depend, recites more than one etching process. Claims 3 and 9 need to specify which previous etching step is being referred to.

In line 1 of claim 5, “include” should be corrected to read “includes”.

Claims 4 and 10 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claims 4 and 10 recite the limitation of “wherein the dielectric layer includes a conductive line.” This limitation does not further limit claim 1, upon which claims 4 and 10 depend, because claim 1 already recites forming a conductive line within the via hole that is formed in the dielectric layer.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 2 and 7-16 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 2 and 8 recite the limitation of forming “an isolated via hole” and “a dense via hole”. However, the specification does not provide specify what size of space between adjacent vias is required for a via to qualify as either “an isolated via hole” or “a dense via hole”. Because the specification does not define “an isolated via hole” or “a dense via hole”, the metes and bounds of claims 2 and 8 cannot be determined.

Claim 7 is not properly dependent upon claim 1. Claim 7 merely appears to be restating the entire process already described in claim 1, only in more detail. As such, claim 7 would be proper as an *independent* claim but not as a claim that is dependent upon claim 1. Claim 1 already recites various processing steps for forming a conductive line including “providing a substrate”, “forming a dielectric layer”, etc. Claim 7 recites many of the same steps already recited in claim 1 such as “providing a substrate”. Claim 7 also recites “forming a first dielectric layer” even though claim 1 already recites the limitations of “forming a dielectric layer”.

In line 18 of claim 7 there appears to be words missing after “an exposed”. As written, line 18 of claim 7 does not make sense.

Claims 8-16 are dependent upon claim 7, which is dependent upon claim 1. Various elements and process steps referred to in claims 8-16 are disclosed in both claim 1 and claim 7

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and, as such, it is unclear as to which elements and process steps claims 8-16 are referring to. For example, claim 8 recites the limitation of "forming at least one via hole includes forming an isolated via hole and a dense via hole."; however, claim 1 recites the step of "forming at least one via hole" and claim 7 recites another step of "forming at least one via hole". Therefore, it is unclear as to whether the "at least one via hole" recited in claim 8 refers to the "at least one via hole" formed in the steps of claim 1 or the "at least one via hole" formed in the steps of claim 7.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

Claims 1, 4, 5, 7, and 10-15 are rejected under 35 U.S.C. 102(e) as being anticipated by Jang et al.

In reference to claims 1, 4, 7 and 10, Jang discloses providing a substrate (10) having a conductive layer (11) therein, and a passivation layer (12) formed over the conductive layer. A first dielectric layer (14), a first etching stop layer (16), and a second dielectric layer (18) are sequentially formed over the passivation layer (Fig. 1; col. 5, ln. 66-col. 6, ln. 60). The second dielectric layer, first etching stop layer and first dielectric layer are then sequentially etched to form at least one via hole which exposes a portion of the passivation layer (Fig. 2; col. 8, ln. 20-

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65). A gap fill polymer layer (24) is deposited to cover the second dielectric layer and fill the via hole (Fig. 3; col. 9, ln. 21-45). Chemical mechanical polishing is performed to remove excess gap fill polymer material lying outside of the via hole (Fig. 3; col. 9, ln. 57-col. 10, ln. 2). A lithographic process uses a photoresist (26b) having an opening above the second dielectric layer to form a trench in wherein the trench exposes the via hole and a portion of the gap fill polymer that remains in the via hole after etching (Fig. 4; col. 10, ln. 31-65). During this trench-forming step, the upper portion of the gap fill polymer layer is etched away and the exposed portion of the second dielectric layer is etched until etching stop layer is reached (Fig. 4). The photoresist layer and the left-over portion of the gap fill polymer are removed and the trench is filled with metal (30) to simultaneously form a plug and a conductive line (Fig. 5; col. 11, ln. 12-60).

In reference to claims 5, 14 and 15, Jang discloses that the first and second dielectric layers may comprise silicon oxide (col. 7, ln. 47-54).

In reference to claim 11, Jang discloses that the conductive layer (11) may comprise a metal (col. 7, ln. 15-16).

In reference to claims 12 and 13, Jang discloses that the passivation layer and the etching stop layer may both comprise silicon nitride (col. 7, ln. 30-45).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jang et al. in view of Sikora.

In reference to claims 3 and 9, Jang discloses that the etching which forms the trench is conducted using a plasma etch but Jang does not specifically state that the plasma etch is anisotropic (col. 10, ln. 66-col. 11, ln. 4; col. 8, ln. 30-46). Jang shows in Figures 2 and 4 that the plasma etching results in vertical sidewalls. Sikora discloses a process of etching via holes in a dielectric layer. Sikora discloses that etching of vertical sidewalls must be accomplished by anisotropic etching (col. 2, ln. 8-25; col. 4, ln. 53-61). As can be seen in Figure 3b of Sikora, isotropic etching of an underlying layer using a photoresist mask, results in sloped walls because the underlying layer is being etched equally in every direction (col. 3, ln. 66-col. 4, ln. 2). Figure 3c of Sikora shows that anisotropic etching of the same underlying layer using a photoresist mask results in vertical sidewalls because the underlying layer is etched faster in the vertical direction than in the horizontal direction. At the time of the invention, it would have been obvious to one of ordinary skill in the art to etch the trench of Jang using an anisotropic process because Jang shows that the sidewalls of the trench are vertical and, as is taught by Sikora, anisotropic etching is required to produce such vertical sidewalls.

Claims 6 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jang et al. in view of Chua et al.

In reference to claims 6 and 16, Jang discloses that the first and second dielectric layers may be formed by a variety of materials but Jang does not specifically disclose that these materials may include organic low-k material (col. 7, ln. 47-56). Chua discloses that it is

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advantageous to replace interlevel dielectric layers of silicon oxide with organic low-k materials because these organic insulators, by virtue of their lower dielectric constant, provide lower capacitance between adjacent metallization lines "thereby improving device performance" (col. 2, ln. 23-40). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use organic low-k material to comprise the first and second layers of Jang because Jang states that a variety of materials may comprise the dielectric layers and, as is taught by Chua, organic low-k material provides the benefits of lowering the capacitance between adjacent metallization lines and thus improves device performance.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

Iguchi et al. and Lin et al. disclose forming a conductive line and via by using an organic sacrificial material. The sacrificial material is deposited into a via hole and is then etched back. Subsequently, a trench is etched.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (703) 308-5840. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on (703) 308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

CLN

April 3, 2002


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
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